PRESSURE EXHAUST SYSTEM FOR A CONVECTION COOKING APPLIANCE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention pertains to the art of cooking appliances and, more particularly, to a cooking appliance including a convection cooking system having a controlled exhaust outlet that establishes a pressure differential within the convection cooking system causing fresh air to be drawn into the appliance.

2. Discussion of the Prior Art

In the art of cooking, it is common to incorporate a convection cooking system in an oven for performing a particular cooking process. Typically, convection cooking systems include a fan for establishing a heated airflow by passing oven gases over a heating element prior to re-

introducing the airflow into the oven. In addition to the heated airflow, provisions must be made to exhaust a portion of the oven gases from the oven. Therefore, the convection cooking system must include structure designed to ventilate or evacuate exhaust gases from the appliance.

There are two key components associated with the design of oven ventilation systems. The primary concern is the build-up of gases which include carbon monoxide (CO) and carbon dioxide (CO_2) within the oven. If the gases are evacuated from the oven too quickly, the efficiency of the cooking process, as well as oven pre-heat time, will be reduced. On the other hand, if the gases are evacuated too slowly, a large smoke cloud could pour forth into the kitchen after completion of a closed door cooking process and, in particular, a broil operation. Thus, the ventilation system must be designed to handle the dissipation of the smoke cloud, as well as to promote overall oven efficiency.

The second key component in the design of an oven ventilation system is controlling oven gas exhaust temperature. That is, the temperature of the exhausting oven gases should not be too hot or too low. For example, permitting the exhaust gas temperature to be too low will undesirably develop condensation of the food effluents and steam as the exhaust gases exit the oven.

Several attempts have been made to develop better ventilation systems for ovens. In general, such systems require extensive ducting, catalyst reactors, outlet baffles or the like. While each is effective to a degree, all require the use of additional, expensive components or systems which add to the overall cost and complexity of the oven. In the

highly competitive field of cooking appliances, it is important to deliver a product at a low cost, while maintaining quality and efficiency standards. Therefore, despite the existence of various oven ventilation systems in the prior art, there still exists a need for a low cost, relatively simple oven ventilation system that provides the proper balance between exhaust gas temperature and exit velocity.

SUMMARY OF THE INVENTION

The present invention is directed to a cooking appliance incorporating a convection heating system including a ventilation arrangement having a pressure exhaust system. Specifically, the convection system includes a housing unit having an interior portion within which is arranged at least a fan assembly, a heating element and an exhaust outlet portion. The exhaust outlet portion has arranged therein a plurality of controlled, vented openings, the number and size of which control a flow rate and volume of exhaust gases exiting the appliance.

In accordance with a preferred form of the invention, the heating element, preferably a sheathed, electric resistive element in the form of a halo, is positioned outside a perimeter of the fan assembly such that an airflow generated by the fan passes over the heating element. With this arrangement, a high pressure area is established just outside the fan perimeter and around the heating element. In a preferred arrangement, the exhaust outlet portion is positioned within the high pressure area such that a portion of the airflow is forced out at a controlled rate through the vented openings.

Correspondingly, as the airflow passes through the exhaust outlet, a slight reduction in pressure occurs creating a low pressure zone within the convection system. This pressure reduction is most pronounced at an inner portion of the fan assembly. Therefore, oven gases passing from the system at an established rate cause fresh air to be drawn into the system at a corresponding rate. With this arrangement, oxygen (O_2) is available in sufficient amounts to provide for substantially complete combustion of airborne byproducts. Accordingly, a reduction of smoke, condensation and built-up food effluents is realized within the cooking appliance. Furthermore, CO generated by the cooking process is maintained at minimum levels such that smoke and other emissions remain below industry standards. Moreover, by controlling the exhaust flow rate, gases carried through the exhaust ducts have sufficient time to cool prior to being released into the surrounding environment.

Additional objects, features and advantages of the present invention will become more readily apparent from the following detailed description of a preferred embodiment when taken in conjunction with the drawings wherein like reference numerals refer to corresponding parts in the several views.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a partial perspective view of a cooking appliance, shown in the form of a wall oven, including an overall convection and pressure exhaust system constructed in accordance with the present invention;

Figure 2 is a plan view of the overall convection and pressure exhaust system of Figure 1; and

Figure 3 is a cross-sectional side view of the convection and pressure exhaust system of Figure 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With initial reference to Figure 1, a cooking appliance constructed in accordance with the present invention is generally illustrated at 2. Although cooking appliance 2 is depicted as a dual wall oven, it should be understood that the present invention is not limited to this particular model type and can be incorporated into various other types of oven configurations, e.g., cabinet mounted ovens, free-standing ranges and slide-in ranges. In the embodiment shown, cooking appliance 2 includes an upper oven 4 having upper oven cavity 6 and a lower oven 8 including a lower oven cavity 10. Upper oven 4 is preferably designed to perform a combination microwave/convection cooking process, while lower oven 8 is adapted to perform a conventional, radiant cooking operation. As shown, cooking appliance 2 includes an outer frame 12 for, at least partially, supporting both upper oven 4 and lower oven 8 within associated wall structure (not shown).

In a manner known in the art, a door assembly 14 is provided to selectively provide access to upper oven cavity 6. As shown, door

assembly 14 is also provided with a handle 15 at an upper portion 16 thereof. As further shown in Figure 1, door assembly 14 is adapted to pivot at a lower portion 18 to enable selective access to within oven cavity 6. In a manner also known in the art, door assembly 14 is provided with a transparent zone 22 for viewing the contents of oven cavity 6 when door assembly 14 is closed. In addition, a seal (not shown) is provided about a peripheral edge portion (not separately labeled) of door assembly 14 to prevent oven gases from undesirably escaping from oven cavity 6. In a similar manner, a second door assembly 24 is provided for lower oven 8.

As best seen in Figure 1, oven cavity 6 is defined by a bottom portion 27, an upper portion 28, opposing side portions 30 and 31 and a rear portion 33. In the illustrated embodiment, arranged on an outer rear surface of upper oven 4 is a microwave cooking system generally indicated in phantom at 37. As shown, microwave cooking system 37 includes a waveguide 39 having arranged thereon a microwave emitter or magnetron 40. As further shown in Figure 1, cooking appliance 2 includes an upper control panel 50 arranged above upper oven 4 and carried at least partially by frame 12. In the embodiment shown, control panel 50 includes first and second rows of oven control buttons 52 and 53 for programming, in combination with a numeric pad 55 and a display 57, particular cooking operations for upper and lower ovens 4 and 8 respectively. Since the general programming and operation of cooking appliance 2 is known in the art and does not form part of the present invention, these features will not be discussed further here. Instead, the general structure described above with respect to cooking appliance 2 is already known in the art and does not constitute part of the present

invention. Therefore, this structure has only been described for the sake of completeness. Instead, the present invention is particularly directed to a convection heat system and, more particularly, to a convection heat system incorporating a pressure exhaust system.

Referring to Figures 1-3 illustrating a preferred embodiment of the present invention, cooking appliance 2 further includes a convection heating system indicated generally at 70. As shown, convection heating system 70 includes a convection fan housing 75 having an outer peripheral portion 77 and an interior portion or chamber 78. Extending from opposing side portions of outer peripheral portion 77 are mounting flanges 79 and 80, each of which includes a plurality of apertures 82 for securing convection heating system 70 to an upper exterior portion 89 of oven cavity 6.

As best seen in Figure 3, arranged within interior portion 78 of housing 75 is a fan assembly 95. In the embodiment shown, fan assembly 95 includes a fan 99 which is driven by a drive shaft 100 of a motor 101. More specifically, fan 99 constitutes a dual flow blower having a first portion 103 adapted to establish an incoming air flow and a second portion 104 adapted to withdraw oven gases from within oven cavity 6.

Arranged about an outer periphery of fan 99 within housing 75 is a heating element 110 which, in accordance with a preferred form of the invention, includes first and second coils 112 and 113. Heating element 110 is secured within interior portion 78 of housing 75 by a plurality of heating element support brackets 120-122 as shown in Figure 2. As best

illustrated in Figure 3, a peripheral wall 124 extends about interior portion 78 of housing 75 between fan 99 and heating element 110. In the embodiment shown, peripheral wall 124 extends radially outwardly of fan 99 and includes a plurality of openings indicated generally at 125. As will discussed more fully below, peripheral wall 124 separates interior portion 78 into an outer chamber 128 and an inner chamber 130.

In accordance with the most preferred form of the present invention, an exhaust duct 140 extends from an upper surface of housing 75, with exhaust duct 140 having a first end 143 opening into outer chamber 128 and extending to a second end 144 which opens to outer chamber 128 for exhaust gases from cooking appliance 2. More specifically, arranged at first end 143 of exhaust duct 140 is a restricter plate 150 including a plurality of controlled openings 152 which, in this most preferred embodiment, establish a flow rate and volume of the exhaust gases exiting from outer chamber 128 through exhaust duct 140.

Having described a preferred construction of the convection cooking system of the present invention, reference will now be made to Figures 1-3 in describing a preferred method of operation. Upon application of an electric current to motor 101, fan 99 begins to rotate so as to establish an air flow within interior portion 78 of housing 75. Initially, the air flow developed by operation of fan 99 passes through openings 125 in peripheral wall 124, thereby creating a high pressure zone indicated at H within outer chamber 128. The development of the high pressure zone H forces a first portion of the air flow (indicated generally at A) through outlets 156 of housing 75 which open into oven cavity 6. At the same time, the high pressure zone H forces a second

portion of the air flow through openings 152 in restricter plate 150, thereby establishing an exhaust air flow. The exhaust airflow is subsequently directed through duct 140 and away from cooking appliance 2.

In accordance with the invention, the flow rate of exhaust gases through duct 140 is established by a pressure differential between outer chamber 128 and the restriction created by restricter plate 150. Depending upon the particular geometries of the overall cooking appliance, openings 152 can be adjusted in both number and size to allow a greater or lesser amount of exhaust gases to pass from outer chamber 128 into exhaust duct 140. In addition to performing a cooking operation with the above described convection cooking system, appliance 2 includes a broil element 175 mounted adjacent housing 75 within oven cavity 6. As shown, broil element 175 includes a first, generally spiral shaped portion 178 interconnected to a second, generally spiral shaped end portion 180 through an intermediate S-shaped portion 182. With this construction, upon selection of a broil operation, broil element 175 is activated to efficiently and effectively direct heat upon a food item positioned there below.

As the air flow passes through outer chamber 128, a corresponding low pressure area, which is generally indicated at L in Figure 3, is established within inner chamber 130. Low pressure zone L draws fresh air into housing 75 through inlet portion 190. As shown, a fresh air flow, generally indicated at D, enters inlet portion 190, travels through a passage 192 and flows into inner compartment 130 through openings 195. In this manner, the level of oxygen (O_2) present within convection

heating system 70 can be controlled such that the combustion of food effluents is maintained within accepted industry standards. In addition, controlling the level of oxygen (O_2) within the system lowers the carbon monoxide generated to absolute minimum levels as determined by the thermodynamics of the overall system.

In accordance with the most preferred form of the present invention, air flow generated by fan assembly 95 is constituted in part by oven gases withdrawn from oven cavity 6 through intake portion 170. As oven gases generally contain food effluents, directing the oven gases over heating element 110 in the presence of the incoming, fresh air flow enhances the overall combustion of food effluents.

Although described with reference to a preferred embodiment of the present invention, it should be readily apparent to one of ordinary skill in the art that various changes and/or modifications can be made to the invention without departing from the spirit thereof. For instance, it is contemplated that interchanging the respective positions of the convection heating system and the microwave heating system fall within the scope of the present invention. In addition, while the broiler element is shown to be substantially spiral in shape, a wide variety of broiler element configurations, such as a standard serpentine element, could be employed. In general, the invention is only intended to be limited to the scope of the following claims.